A Guide to Atmosphere-Supplying Respirators

Atmosphere-supplying respirators provide clean breathing air from a source independent of the work area. These respirators will protect wearers from many types of airborne contaminants (particles, gases, and vapors) and, in certain cases, oxygen-deficient atmospheres. There are three types of atmosphere-supplying respirators: supplied-air respirators (SARs), self-contained breathing apparatus (SCBAs), and combination SARs/SCBAs. Respirators need to be approved by the National Institute for Occupational Safety and Health (NIOSH) Respirator Approval Program and used in the context of a complete respiratory protection program per the Occupational Safety and Health Administration (OSHA) regulation 29 CFR 1910.134, which includes annual fit testing for all respirators with a tight-fitting facepiece.[1]

Supplied-Air Respirators

SARs are connected by an airline hose to a free-standing cylinder of breathing air, an air compressor, or a system supplying breathing air through the building. They are sometimes referred to as airline respirators. At a minimum, the breathing air must meet the requirements for Grade D breathing air.[2] They can be lightweight and used for long, continuous periods in atmospheres that are not immediately dangerous to life and health (IDLH).[3] However, a disadvantage of the SAR is that the respirator user's mobility is limited by the length of the air supply hose.

Photo courtesy of Honeywell International Inc.

SARs deliver air to the user in multiple configurations including continuous-flow, demand, or pressure-demand. Continuous-flow SARs maintain airflow at all times. Demand and pressure-demand systems provide air based on the user's breathing. Demand systems will cause negative pressure in the facepiece during inhalation. Pressure-demand systems maintain a positive pressure within the facepiece during use, which means that if leakage occurs, the airflow should be directed outward.

Supplied-air respirators are available in configurations with hoods and helmets as well as tight-fitting facepieces. When utilized within a respiratory protection program, SARs generally have high assigned protection factors (APF), according to OSHA. A respirator's APF is the minimum level of respiratory protection it is expected to provide when used as part of a workplace respiratory protection program. A respirator with a higher APF number gives better protection: an APF of 10 means that 1/10 of a contaminant outside the facepiece might be inhaled and an APF of 1,000 means that 1/1,000 of a contaminant outside the facepiece might be inhaled.

OSHA Assigned Protection Factors				
Supplied-Air Respirator or Airline Respirator	Half Mask	Full Facepiece	Helmet/Hood	Loose-fitting Facepiece
Demand Mode	10	50	-	-
Continuous Flow Mode	50	1,000	25/1,000[4]	25
Pressure-Demand or other positive pressure mode	50	1,000	-	-

[1] Refer to OSHA 29 CFR 1910.134(f)(8) for atmosphere supplying respirator fit test requirements.
[2] Compressed breathing air must meet at least the requirements for Type 1 - Grade D breathing air described in ANSI/CGA G-7.1-1989
[3] Table of IDLH values
[4] The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a workplace protection factor (WPF) or simulated workplace protection factor (SWPF) study or equivalent testing. Absent such testing, all other SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25. (29 CFR 1910.134(d)(3)(i)(A))

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Self-Contained Breathing Apparatus

SCBAs are equipped with their own breathing air supply. Because of the portable air cylinder, unrestricted movement is an advantage of SCBAs. However, the limited service life makes them unsuitable for routine use for long, continuous periods. The length of service life depends on the SCBA type.

SCBAs are categorized as open-circuit and closed-circuit devices and can be used for entry into and escape from atmospheres that are considered IDLH or oxygen deficient.

Open-Circuit SCBAs

Open-circuit SCBAs are usually equipped with a full facepiece and contain their own breathing air supply in a pressurized cylinder that is worn on the back of the user. Typically, this is the type of respirator worn by firefighters. These respirators exhaust exhaled air into the atmosphere instead of recirculating it. Since there is no recirculation of breathing air, the service life of the open-circuit SCBA is usually shorter than a closed-circuit device. Open-circuit SCBAs have a service life of up to 75 minutes. There are two types of open-circuit SCBAs, demand and pressure demand. The demand-type respirator only allows air into the facepiece as needed by the user. A demand-type open-circuit SCBA should not be used in IDLH atmospheres.

Photo courtesy of 3M Scott

The pressure demand-type respirator is designed to maintain positive pressure in the facepiece at all times.

Closed-Circuit SCBAs

Another name for a closed-circuit SCBA is a "rebreather" device. The breathing gas is recycled after going through a process to remove the exhaled carbon dioxide and replace the oxygen consumed by the user. Closed-circuit SCBAs are approved for both entry and escape, or escape only. Entry and escape devices have a duration of one to four hours. They are designed for use in oxygen deficient and/or IDLH atmospheres such as those that might be encountered in mine rescues or confined spaces.

Escape-only closed-circuit SCBAs, known as closed-circuit escape respirators (CCERs), are used in certain industrial and other work settings during emergencies to allow users to escape from IDLH or oxygen deficient environments. The duration of a CCER is dependent on two things: (1) the total amount of oxygen available to the user (i.e., capacity) and (2) the oxygen consumption rate. CCERs are also known in the mining community as self-contained self-rescuers (SCSRs), and in other industries as emergency escape breathing devices (EEBDs) or apparatus (EEBAs).

CCER, Photo courtesy of Ocenco

Self-Contained Breathing Apparatus (continued)

An SCSR is similar in design to the entry and escape closed-circuit SCBAs, but is considerably smaller and weighs less. Because it is an escape-only device, this type of CCER can only be used for up to one hour.

SCSR, Photo courtesy of CSE

OSHA Assigned Protection Factors			
SCBA	Half Mask	Full Facepiece	Helmet/Hood
Demand Mode	10	50	50
Pressure-Demand or other positive pressure mode (e.g., open/closed circuit)	-	10,000	10,000

Combination Supplied-Air/Self-Contained Breathing Apparatus

A combination SAR/SCBA incorporates a backup self-contained air supply. The self-contained portion of the device is only used when the primary air supply fails or becomes interrupted. Typically, the self-contained air supply is small, since it only needs to supply enough air to safely escape from a hazardous environment. Due to the typical short service life of the self-contained breathing air supply, these combination units are generally used for emergency escape from IDLH atmospheres. In certain circumstances, when larger air cylinders are used, entry into an IDLH environment is permitted, provided no more than 20% of the rated air supply is needed for entry.

Photo courtesy of 3M Scott

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